THICK-WALLED BASIDIA IN AGARICS

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SUMMARY. With discussion the new term *crassobasidium* is proposed for the thick-walled basidial structures found in agarics and particularly in the genus *Armillaria*.

RÉSUMÉ. - Proposition, avec discussion, du terme nouveau de *crassobasidium* ou crassobaside pour définir les éléments basidiaux à paroi épaisse que l'on observe chez certains agarics et notamment dans le genre *Armillaria*.

A prerequisite for any studies on ecology and pathogenicity of a particular fungus is its correct identification. In many studies such accurate determinations have been achieved but failure to differentiate species of *Armillaria* has led over the last twenty five years to confusion in the literature and difficulties in explaining the behaviour or role of different taxa in different diseases of forest trees, ornamentals and fruit crops, and in natural communities.

Prof. ROMAGNESI has done much to rectify this omission indeed he has probably contributed more than any other single author towards making mycologists and plant pathologists aware that more than one species of *Armillaria* exists in Europe. His studies (ROMAGNESI, 1970; 1973) have been paramount in unravelling and delimiting the taxa involved and are now the basis of many corridors of study both classical and experimental. The realization of the presence of several common pathogenic European species of *Armillaria* is of great importance.

Through this work and the senior author's experiences in the British Isles, an examination of Australian species of the genus *Armillaria* appeared to be necessary as in that continent *A. mellea* (Vahl ex Fr.) Kummer was considered a widespread pathogen. KILE & WATLING (1981, ined.) are at present undertaking a survey of the species involved but because of suggested similarities

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between the Indo-Malaysian vascular plant flora and some elements in the Australian plant flora the present authors thought it necessary to reappraise taxa described from the Indian sub-continent. During this survey (WATLING & CHANDRA, ined.) the presence of thick-walled basidia in the hymenium had to be considered.

SINGER (1951 a) was the first to draw attention to the fact that thick-walled basidia were found in the hymenium of certain species of agaric. It was shown by him that these structures were useful in delimiting taxa and that they varied considerably in morphology. In studies by SINGER & CLÉMENÇON (1972) such structures in *Armillaria* were shown to be characteristically 7-nucleate.

During our study of Indian species of *Armillaria* the opportunity was taken to determine whether the occurence of thick-walled basidia was significant and suitable as a taxonomic character. As this was found to indeed be the case a search for thick-walled basidia in all collections of this genus is made routinely. In recent studies on European (MARXMULLER, 1982) and Australian taxa (KILE & WATLING, in press) the distribution of thick-walled basidia has been documented.

Such structures have been called sclerobasidia by SINGER (1951 a & subseq.) but this term is unacceptable.

According to SNELL & DICK (1957) the term sclerobasidium was introduced by JANCKER (1923) for a thick, encysted gemma-like probasidium found in the Uredinales and Auriculariales. It was considered a resting cell resistant to external changes. The application of such a term to the thickened basidia in *Armillaria*, if not all agarics, is therefore unjustified. In contrast AINSWORTH & BISBY (1961) equate the sclerobasidium with the hypobasidium of members of the Heterobasidiomycetes, especially the teleutospore of the Uredinales and chlamydospore of many Ustilaginales. Thus even applying the term in its original sense it covers two quite different organs, ie, the teleutospore consisting of a probasidium which develops into an external metabasidium or transforms into an internal metabasidium, and a dangeardian which produces a non septate germ-tube with apical spores (Tilletiales), or a four-celled germ-tube lacking forceably discharged ballistospores (Ustilaginales).

The structures in *Armillaria* cannot therefore be called sclerobasidia. For these structures we therefore propose the new term *crassobasidium*. Crassobasidia (Fig. 1) range in morphology from structures possessing very thick often coloured walls when they are easily recognised, to only slightly thickened walls when they can be distinguished from more normal basidia by their rigid nature, their glassy appearance especially under phase contrast and the often accentuated, strongly curved sterigmata; these same cells are often broader or more elongated than normal basidia. In addition they often produce thickened spores and become once or more septate, more rarely twice, above mid-way or in the pedicel of the basidium. In ammoniacal or alkali mounts of the hymenium crassobasidia stand out against the surrounding hymenial cells; rarely are they cystidioid but they sometimes fragment.

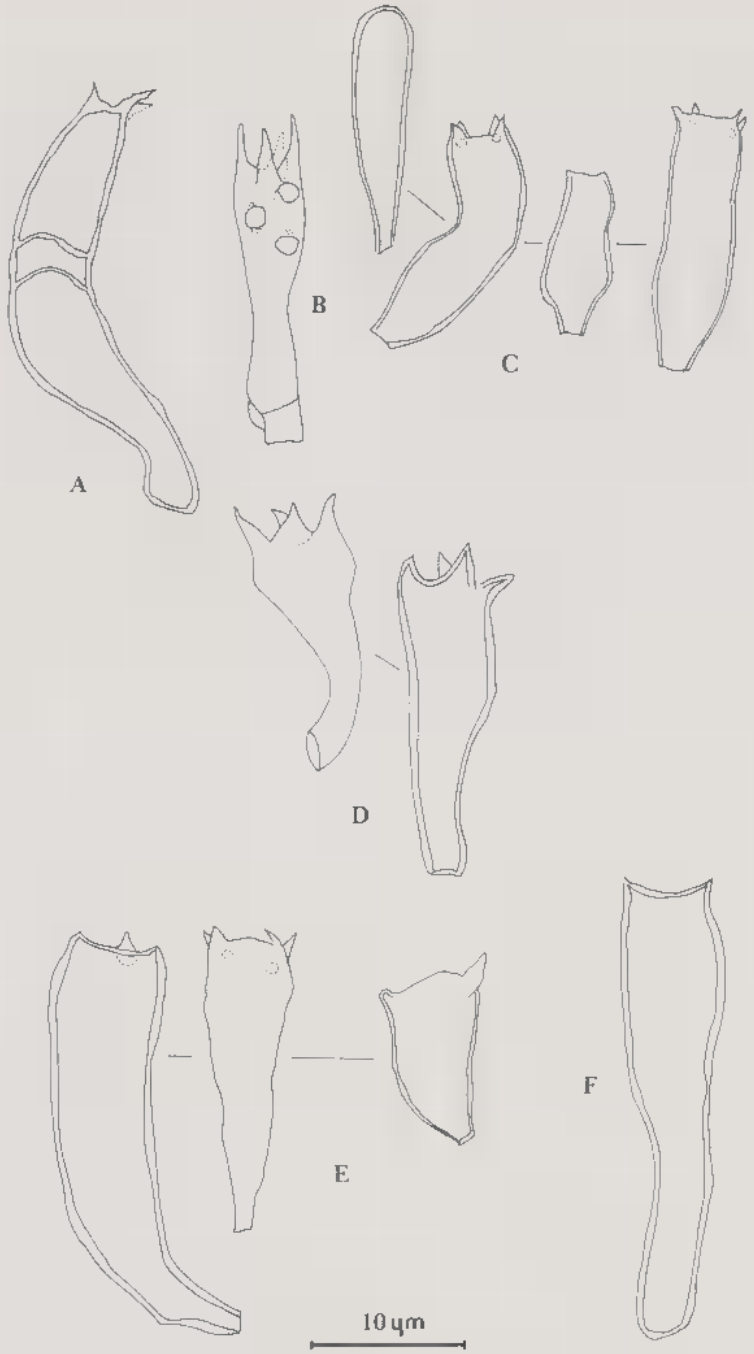

Fig. 1. – Basidium in *Armillaria* spp. : A. septate crassobasidium, *Armillaria vara* Pakistan, Shi Mycological Herb. 2208; B. *A. adelpha* : Daarjeeling; C. *A. adelpha* : Sikkim; D & E. *A. fuscipes* from Peradeniya; F. *A. mellea* agg. 2178 from Pakistan. Material all in K.

It is suggested that the sclerotised basidium is possibly a step towards an abbreviated life-cycle where on the elimination of spore formation the basidia act as propagules themselves. However, it is difficult to imagine the selective advantage of such structures scattered in what is otherwise a normal hymenium, when compared for example with members of the Podaxales (HEIM, 1932). Members of this order characterise arid regions and a possible functional pattern for thickened structures in such an adverse environment can be appreciated. There is no indication either from personal observations or those of Aindrila CHANDRA working with Indian species of *Armillaria* or from the literature that basidiospore ejection takes place in these crassobasidia, or whether the spores so formed function normally; cultural studies have not elucidated this. In contrast in some species of *Fayodia* s. l. thick-walled basidia of normal function are exceptionally found in this genus according to SINGER (1962).

SINGER (1951 a), because of the taxonomic significance of crassobasidia, has proposed a relationship between members of the *Armillaria mellea* group and species of *Aeruginospora*, eg. *A. singularis* (Hoehnel) Singer, and even *Hygrophorus hymenocephalus* Smith & Hesler. Crassobasidia can be located in the hymenium of these last hygrophoroid agarics. SINGER (1951 a) in the arrangement he adapted for these fungi realized the presence of a hiatus but suggested that once *Armillariella* (= *Armillaria*) was clearly delimited from *Omphalina*, this would be solved and a new arrangement for these fungi could be expected. Crassobasidia have not been found in any species of *Omphalina* so far studied nor have they been found in members of the genus *Clitocybe*, a taxon in which *Armillaria mellea* has often previously been placed (WATLING, KILE & GREGORY, 1982).

Since 1951 *Armillaria densifolia* Singer apud Singer & Digilio has been transferred to *Lulesia* (SINGER, 1970) and *A. ditopa* Singer to *Arthrosporella* (SINGER, 1970), and the genus *Omphalina* restricted and linked to *Clitocybe* whilst many of its traditional species were transferred to an expanded concept of *Gerronema* Singer, a genus described in 1951. The *Aeruginospora* group was recognised by SINGER as being distinct in 1962 and returned to the *Hygrophoraceae* s. auct. pl. This is the best solution at the moment simply utilizing the morphology of the hymenial elements, but with the proliferation of genera a new look at all the tricholomataceous agarics is urgently required.

At present all the armillarioid taxa observed with crassobasidia in Australia and India belong to the genus *Armillaria*, albeit in some cases to undescribed taxa; material in national herbaria which has been examined and found not to belong to this genus has been shown to be because the original material was mis-identified in the first instance.

One of us (RW) would like to thank Helga MARXMULLER for helpful discussion which unfortunately took place whilst her paper on European species of *Armillaria* was at press.

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